The Citrus Industry
EXCLUSIVE SPECIALIZED CITRUS PUBLICATION
Issued Monthly
Representative of every interest
Representing no special interest

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Factors Influencing Development And Control Of Scale Insects On Citrus . . .

By W. L. Thompson

Associate Entomologist, Citrus Experiment Station, Lake Alfred, Fla., . . . At Meeting Florida State Horticultural Society . . . .

The program of satisfactory control of scale insects has apparently become more acute during the past few years than formerly. This has made necessary a more careful study of the factors influencing their development as well as improvements in the methods of control. Purple scale, **Lepidosaphes beckii** (Newm), and Florida red scale, **Chrysomphalus aonidum** (L), are the two most important species of scale insects from an economic point of view. This paper is more or less a review of work published by your speaker in the proceedings of the Florida State Horticultural Society and in The Citrus Industry, along with some additional information secured during the past year. The more detailed results from various experiments may be found in the publications listed at the end of this paper.

Factors Influencing Scale Development

The factors influencing scale development in Florida are varied and recently the number of factors has been increased due to changes in cultural practices. In December, 1938, your speaker published an article in The Citrus Industry (3) citing some reasons for the recent increase of scale infestations and one of those reasons was the use of residue sprays of a non-insecticidal nature, such as precipitates of copper, zinc, and manganese. It has been demonstrated that purple and Florida red scale infestations develop more rapidly following such sprays than when they were omitted, and that the scale population was more or less proportional to the amount of residue left by the spray. For example, at the end of the year there was a heavier infestation of scales following bordeaux 6-6-100 than following 3-3-100 or a neutral copper 3-100 even though the scale fungi were as abundant in one plot as in the other. At the end of a three-year period purple scales were more abundant in two plots receiving yearly sprays of zinc sulfate-lime 4-2-100 plus sulfur than in two other plots receiving zinc oxide 2-100 plus sulfur. Other residues are also a factor in purple scale development. For instance, it is common knowledge that scales are more abundant on trees along unpaved roads than in the center of the grove and the same effect may be produced in groves that have been cultivated repeatedly during dry periods, such as those experienced during the past year, or when fertilizers of a dusty nature are applied with mechanical spreaders. Sooty mold on leaves furnish favorable protection for purple scale crawlers. By actual count of purple scales on leaves from trees similarly treated within the same block, the infestation was heavier when the leaves were covered with sooty mold than when they were fairly free from it.

The growing condition of the trees is also a factor in scale development. Trees in a thrifty growing condition with a high percentage of green leaves are more suitable for scale development than trees that are hard or have a large percentage of bronzed and frenched leaves. Purple scales were more abundant on trees where a magnesium deficiency had been partially corrected than on adjacent trees where the magnesium deficiency still existed and where there was a high percentage of bronzed leaves (3). On "frenched" leaves, due to zinc deficiency, there were only one-third as many scales as on green leaves of the same age on adjacent twigs.

Shade must be considered as a factor in influencing scale infestations. The more recent practices of supplying certain elements of plant food which include zinc, manganese, and magnesium, to the trees has resulted in larger trees with more foliage which creates shaded conditions ideal for purple scale development. As stated by Thompson (4) in corroborating this fact, trees covered with half-shade in a slat house had more scales than adjacent trees without shade. Also trees that were

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surrounded by a solid shade for windbreaks but open at the top, had more scales than adjacent trees, and trees within the same plot had more scales on leaves where the foliage was fairly dense than on trees with sparse foliage.

Seasonal conditions also play an important part in scale development. During the past three years purple scales have increased very materially between October and February, a period when scale development is ordinarily slow. All of the above discussed factors, together with other undetermined ones, have resulted in heavier and more consistent infestations which have made the problem of control more difficult.

Methods of Determining The Program For Scale Control

One of the outstanding weaknesses in scale control is the failure of many field men to recognize the potential infestation early in the year, and in many cases when the inspection is made he is undecided as to whether he can get by with sulfur sprays or whether oil is necessary. The old axiom used in the cards "when in doubt lead trump," might be used in deciding the material used for scale control—when in doubt use oil. Nevertheless, there are many times when sulfur sprays will be sufficient if applied thoroughly.

It is very difficult to put in writing a practical guide to designate varying degrees of scale infestation for the field man to use. Very careful inspections and observations are necessary. The opportune time to begin the inspections is during early January when the trees have the minimum amount of foliage on them for it is from old leaves that part of the infestation will come.

If the inspection is not made until May or June the older leaves are more or less hidden by new foliage which has not yet become infested so that to all outward appearances the trees have a light infestation, whereas in reality a potentially heavy infestation may be present on the older leaves and twigs. At the time of the early inspection, if a small percentage of the leaves have yellow spots on them it is a sign that a large percentage of them are infested and oil should be used during the summer. If some of the leaves, especially those on inside twigs, are examined through the hand lens many young scales will be observed that might otherwise be overlooked because of residue on the leaves. Colonies of scales can also be detected on leaves on higher limbs by looking up through the center of the tree against the sun. The amount of sooty mold and other forms of residue should be considered. If sooty mold is present in any quantity oil should be used, not only to control the whiteflies and scales but to remove the sooty mold which is a protection for scale crawlers. Sulfur sprays are not very effective if the young scales are protected by sooty mold. As to the other residues on the leaves, the program of the past year should be reviewed as well as considering the present year's program. If copper, zinc, or manganese sprays were used singly, or combined, without an oil follow-up, a very careful examination for a general infestation of scales should be made. If those materials were applied to trees with very light infestations of scales, the increase of population may not be very noticeable the first year because the scales are scattered over the leaves and have not built up enough to cause many yellow spots, but from such a general infestation a very heavy one may develop during the second and third years. Suckers and other inside succulent leaves should be examined since that type of growth is an excellent breeding place for purple scales. The fact that suckers and leaves on small inside twigs are often heavily infested is a very good indication that leaf infestations often come from infested wood. Three of the most important places to look for purple scales are on twigs, limbs, and the trunks of trees. Even though the leaves may be fairly free of scales the limbs and twigs may be infested and if that condition exists, oil should be used. The armor, or covering, of the purple scale has much the same color as the bark of the tree and for that reason purple scales on the wood are often overlooked. Again the hand lens should be used to really get a picture of the infestation on the bark. In early March of this year your speaker counted as high as fifteen crawlers and young scales that had just settled in an area of less than one square inch on a grapefruit limb five inches in diameter. The leaves on that tree were not heavily infested, but there were prospects for a heavy infestation by mid-summer or early fall because scales were already settling on young twigs. Chaff scale, **Parlatoria pergandii** Comst., is also a serious pest on the trunks and limbs of the tree and heavy infestations should be controlled. The individual making the inspection for scale infestations should not be misled by the fact that sometimes 80 to 90 per cent of the scales are dead, especially early in the year, because the remaining 10 to 20 per cent are enough to cause heavy infestations.

Individual block records of scale infestations from year to year is a valuable guide. If the individual making the inspection can fix in his mind, or have a gauge to go by, as to what constitutes light, medium, and heavy infestations the success or failure of certain programs can be determined from his records. Most field men can recognize a heavy infestation, but it is with the light to medium infestation that the uncertainty arises as to which to use, an oil or lime-sulfur. The guide we use is the average number of living scales per leaf, but that method is not practical for field men although it can be modified for practical use. An infestation of purple scales averaging two living scales per leaf is on the margin, that is, the scale can easily be controlled with an oil spray and if conditions are right, lime-sulfur sprays may keep it in check or reduce it. Infestations varying from less than an average of one to one and one-half living scales per leaf have been held down very satisfactorily with sulfur sprays. If the program should fail there are not enough scales to do a great deal of damage within a year unless heavy residue sprays or other like factors enter in. To illustrate, for the last four years a block of eighteen-year old Pineapple orange trees have been sprayed with nothing but lime-sulfur sprays, except for one application to which wettable sulfur was added. When the experiment was started there was an average of less than one living scale per leaf. For three years the scales did not increase to over an average of one living scale per leaf but during the last year the scales increased to an average of two living scales per leaf. The first three years the lime-sulfur was applied at strengths varying from 2 to 1½ gallons per 100 gallons but the last two applications were at 1 1-4 and 1 to 100 gallons. From three to four applications were made per year. Although the infestation has increased during the past year there has been little or no dead wood from scale injury and the infestation can be brought down to a minimum this summer with one thorough oil spray.

The question now arises as to how the field man can determine the average number of living scales per leaf. Your speaker has reviewed the results of a great many experiments conducted since 1933 and where there was an average of less than 1.5 living scales per leaf, over 50 per cent

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Planting Crotalaria As A Cover Crop

By J. Lee Smith
DISTRICT AGENT, AGRICULTURAL & EXTENSION AGRONOMIST

There are some 600 species of crotalaria known, scattered throughout the world, but growing largely in the tropical and sub-tropical countries. It belongs to the legume family. Some are annual and others are perennial herbaceous plants. There are about five kinds native to America.

About twenty-five of the most promising species have been tested in this country — mostly at the Florida Experiment Station — as cover and forage crops.

Three of the most promising species are spectabilis, striata, and intermedia. Spectabilis plants grow to a height of six feet, are moderately branched, and have heavy foliage, large simple leaves two to three inches wide and four to eight inches long, large, pithy stems, large- yellow flowers on long terminal racemes; large pods which become almost black with maturity, and large, glossy black seed. It matures most of its seed at one time and is a heavy seeder.

Striata plants are large, upright, and diffusely and freely branched. This species is annual with trifoliate leaves, small yellow flowers, straw colored seed pods, small brown to olive green seed, and wooly willowy stems. It is a heavy seeder. It is very susceptible to pumpkin bug attack.

Intermedia plants grow six feet high, are very erect, and moderately branched. Its stems are small trifoliate and its leaves are linear and linear oblong. It has small seed. It is a sweet annual. It matures most of its seed at one time.

For a cover crop and a soil improving crop a plant to be used must meet very rigid requirements. It must produce a dense shade and a heavy tonnage of green manure. It also must carry a lot of plant food elements back to the soil and be a heavy producer of seed.

These three species, the spectabilis, striata, and intermedia, appear to have a wide range of adaptation and limitations. They have been grown successfully throughout the South. The spectabilis has done well in the Middle West.

None of these species is adapted to wet situations. A well drained soil is essential to good growth. After the young seedlings get well established they will stand and grow well during the most severe droughty periods I have seen in the south. They do best on the light sandy loam to the clay loam soils. When the land is too poor for velvet beans and soy beans to grow, crotalaria will do well. From such soils I have pulled the striata and found the tap roots from three to four feet deep.

Seeding

When growing for green manure or soil improving crops, seeding can be done from April first to July first. Corn planting time is probably best. The conditions of the season or amount of soil moisture is more important than the date. A good season should be in the soil or near on its way when seed are planted. If planted during the early part of the season, the young seedlings get established and begin to grow ahead of grass and other weeds.

Crotalaria can be seeded broadcast, in close drills and in narrow or wide rows. Drilling or seeding in rows save seed. Three to four pounds seed are sufficient to plant an acre in two foot rows. Eight or ten pounds will be required to plant it in six inch drills and ten or twelve if sown broadcast. Planted in two foot rows and middles ploughed out one time will give as large tonnage as if sown broadcast. Last, when sowing seed in the corn middles to be covered at plowing of corn, ten or twelve pounds seed should be used.

If seed is broadcast and seed is disked in, a roller should be rolled over the seeded field to firm the soil. The little seedlings will live better when they come up through the semi-compact soil.

Seed should be covered from one to four inches deep owing to type of soil and soil moisture present.

Inoculation and Fertilization

Artificial inoculation of seed is not necessary. The organisms that inoculate crotolaria seem to be generally distributed as shown by widely separated tests. Native species are distributed throughout the eastern and southern United States and may be a factor in the distribution of the inoculating organism.

No tests yet made have shown nitrogen, Phosphate, and potash applied directly to the crotolaria is necessary. Some of the minor elements, such as do seem necessary when not available.

Scarifying Seed Results

Seed may or may not be scarified. What is wanted is a good stand. Under laboratory conditions one always gets a much better germination from scarified seed. But under field conditions, that is by no means true of the previous year's seed. If seed two years old or more is used one will usually secure a better stand. The stand from scarified seed may be better sixty days from planting but there is a chance it will not, even though the germination was better. It takes less moisture to germinate scarified seed. If but little moisture is in seed bed, the seed may all germinate and dry season follow. In such case small seedlings die off from drought and no stand is obtained, probably a complete failure. A large part of non-scarified seed would under such conditions lie in ground till a good season comes and a stand would be obtained. If one plants late, he should use scarified seed and take the risk.

Yields of green matter per acre is almost unbelievable to some who have not seen it grow. Yield from 12 to 15 tons is the common production. This is a mass of vegetation when stands are good. On the Lake Alfred Citrus Experiment Station of deep Norfolk sands on duplicate plots there were obtained a seven year average of top production on duplicate plots of approximately 8 tons compared to 3½ tons for velvet beans, 4 tons for beggarweed and 3½ tons for cowpeas. In air dry material this means 4969 pounds crotolaria, 1960 velvet beans, 2453 beggar weed and 2066 cowpeas. On an 8% moisture basis this meant an actual nitrogen return per acre of 108 pounds for crotalaria, 39 for velvet beans, 29 for beggarweed and 34 for cowpeas. In terms of nitrate of soda this means 675 pounds, 244 pounds, 181 pounds, and 213 pounds respectively.

Where nitrogen or humus was either or both the limiting factor in crop production a crop of crotolaria turned under, either green or dry, has apparently very materially favorably affected the crop following. I have

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Unfamiliar Terms About Fungi

By George F. Weber
PLANT PATHOLOGIST, FLORIDA EXPERIMENT STATION

As the farmer and the plant pathologist become associated with each other through personal contact, correspondence or in publications of newspapers, magazines and bulletins, it is inevitable that terms will be used by the pathologist in discussing plant diseases which may be unintelligible to the farmer. There are a few terms which, if the farmer could learn to recognize and grasp their meaning, would mean much to him when he hears about plant diseases.

Every trade and profession has words adapted to its use. Farmers have racks, separators, disks and brooders; mechanics have their shafts, pulleys, gears and saw-sets; physicians have scalpels, ether and stethoscopes, and plant pathologists have their spores, mycelium, putrescence and taxonomy. Each group of individual workers speaks a language fully understood by members of that group, but not understood by members of any other group except after close association and study.

The language of the farmers differ in Florida. A corn and peanut farmer knows little about a field box and the fruit grower infrequently hears the term middlebuster unless he is also a vegetable farmer. The grain farmer of South Dakota never heard of a middlebuster or a fertilizer distributor unless he thought the latter was a polite name for a manure spreader. The language of the mechanic or the plumber or the electrician, however, is much more universally known from Maine to Oregon and Texas. On the other hand, each has special terms applied to specific objects or operators that require some explanation to the rest of the world before it is fully understood and subsequently used.

We may now go another step further and say that the language of the scientist is universal, meaning that it is understood by scientists the world over. The physician's language is understood by physicians in Ocala, Paris, Singapore or Nome. The plant pathologist's language is understood in Cocoa, Copenhagen or Canton, regardless of the native tongue. When a plant pathologist in Florida states in the English language that a certain disease of tomatoes is caused by the fungus **Stemphylium solani** another plant pathologist in Lisbon of the Portugese tongue understands what specific parasite and disease is referred to. **Stemphylium solani** means one and the same parasitic fungus the world over, although the term "leaf blight", the disease caused by this fungus, may have no definite meaning and would be as confusing among Florida pathologists as among Florida farmers.

Plant diseases may result from unfavorable environmental factors, but for the most part they are caused by **fungi**, and **bacteria** which, as individuals, are plant microscopic in size, but in masses, become visible without magnification. These plants, invisible because of their small size, upon magnification show characteristic features that are always the same on the same kind of plant so that we are able to recognize them by these parts just as we recognize an apple tree by its fruit and distinguish it from a citrus tree by the same fruit. These fungi or bacteria not only have characteristic parts but they also have distinctive habits of growth and the effect of them on a host which they are parasitizing is very nearly the same.

Most farmers of Florida have heard of **Rhizoctonia** or **Fusarium.** Diseases caused by either of these parasites are always very nearly the same wherever they occur. The two cannot be confused because they cause different effects on the host plants, even though the fungi causing these diseases are very much alike and could not be distinguished except after careful study. Each of them has a distinctive **mycelium** which is a vegetative growth of small cells joined together in a line much the same, for Rhizoctania, as barrels placed end to end and, for Fusarium, as drainage tile of like diameter. Thus they can be distinguished by one familiar with these characteristics because in one the cells are bulged out on the sides and in the other they are straight. Some cells branch, starting a new series of cells or **hyphae** and, eventually, after continued branching a mass becomes visible of such fine texture it cannot be qualified and has no apparent beginning or end. When this mass of **mycelium** and **hyphae** is sufficiently magnified, the individual cells can be distinguished and their contents can be seen moving about within the cells like liquid in a glass tube. The **mycelium** may penetrate the epidermis of a plant and absorb moisture from it. Thus, we have the plant designated as a **host plant** and the **fungus hyphae** as the **parasite,** because it is getting its food from the plant without beneficial return and will probably kill the plant or part of it.

Some times the **mycelium** forms compact knots on the plant surface usually on the tough skin or bark and forms a **sclerotium** which can resume growth by producing fresh **hyphae** when conditions are favorable for its growth. The fungus may live on the **host plant** weeks, months, or years, but there is a time after it is well established on the host that it propagates itself by the production of **spores** by which means the fungus is distributed and is able to live through periods of drought, extreme temperatures, and other unfavorable periods.

There are many different kinds of **spores,** and often a specific fungus produces several different kinds. Almost all the different fungi produce at least one kind of **spore,** and it is by examination of the spores which are widely viable that the plant pathologist is able to know what kind of a fungus produces them. One might compare the spores of fungi to the seeds of flowering plants. Everyone knows of the difference in size and shape of cabbage and oat seed. We can say that the Rhizoctonia fungus and Fusarium produce spores that are just as different in size and shape.

The pathologists' guiding rule in regard to fungi is **"By their spores we know them."**

When the fungus on a dying plant is **sporulating,** or in the process of producing spores, it is possible to identify it most accurately and for this reason requests for diseased material frequently mention that several stages of the disease be included.

Some **spores** are frequently referred to as **conidia.** They function in every way as **spores** but are generally considered to be more tender and consequently more easily killed. The **conidia** are produced in exceedingly large numbers. They grow on the tips of the **mycelium** on special

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Melanose And Its Control

By H. A. Thulberry
AT MEETING OF FLORIDA STATE HORTICULTURAL SOCIETY

INTRODUCTION:

Mr. President, Members of the Horticultural Society, and Friends:

Melanose control is one of the most important operations on the spray schedule. Much work has been done by the State and Federal Stations and by commercial organizations in the development of proper materials and proper timing.

OBJECT:

Much of the work which has been done has been on experimental plots which were intensively studied as a ground work for commercial practice.

The men in charge of production are interested therefore in taking these data and applying them to their specific needs. In the present paper the writer proposes to show the effect of varying practices on the control of melanose with their commercial values when applied to extensive grove operations.

The work reported was not set up as experimental but was accomplished in the regular routine of the production department of the Haines City Citrus Growers Association.

Not until the pool sheets were studied was it realized that varying practices had such profound significance. The writer feels that these data taken from actual records would be most interesting to all citrus men.

METHODS:

The groves under discussion can be placed in four distinct groups:

GROUP A (3 groves) groves were pruned and had a minimum of dead wood and received a thorough spray application.

GROUP B (2 groves) groves were sprayed but carried a heavy proportion of dead wood.

GROUP C (2 groves) groves were not sprayed but were thoroughly pruned prior to the period of heavy melanose infection on the fruit.

GROUP D (2 groves) groves were not sprayed and had an excess of dead wood.

The spraying was done by the regular spray crews which have been trained to apply a thorough inside and outside coverage without excessive drip. The gallonage for these groves, which averaged twenty years of age, was approximately sixteen gallons per tree. The mixture consisted of two pounds of neutral copper, two pounds of zinc sulphate, one pound of hydrated lime and ten pounds of wettable sulphur containing ninety per cent sulphur and a good wetting agent.

While the neutral copper used in all of these groves reported contained 53% metallic, in other test work comparable results were obtained with coppers of lesser metallic content. The spray was applied between March 15th and April 15th. Zinc sulphate was used for its nutritional value but it also added greatly to the sticking properties of the mixture.

Neutral copper was used instead of Bordeaux mixture for the following reasons:

First, the increased safety factor.

Second, the lessening effect on scale build-up.

Third, the convenience of handling.

The safety factor and the convenience of handling of the neutral coppers are properties which are well recognized.

The direct relationship of increased spray residue to increased scale build-up has been definitely proven by the work of W. L. Thompson (two references), Osborn and Spencer (1 reference), L. W. Ziegler, (unpublished data) and others. In our commercial practices this has proven of great commercial value.

None of the groves herein reported have received an oil spray since the spray application and the scale population is at a minimum.

DISCUSSION:

All fruit reported was marketed in the pool period of Sept. 15th to Oct. 1st. It was picked without regard to grade.

Table No. 1 shows the packout from each grove and the average return per box.

Table No. 2 summarizes the packout of the fruit from the groves in in each group and shows the weighted average return per box.

Group A

A total of 2894 boxes were packed from the three groves in Group A. These groves had been pruned and sprayed. 84% of the fruit went in U. S. No. 1 grade and no fruit graded low enough for canning. The average returns were 61.7c per box.

Group B

The two groves in Group B which had been sprayed but not pruned packed 2290 boxes of which 53% were U. S. No. 1. No fruit graded into cannery class. The average net return was 50.7c per box.

Group C

The two groves in Group C received a thorough pruning but received no spray application. Of the 881 boxes 40% packed U. S. No. 1 and 5.4% went into cannery grade. The average return was 44.7c per box.

Group D

These two groves received no control measures against melanose infection. 21% of the 1440 boxes

TABLE NO. 1
FRUIT, GRADES, AND RETURNS

GROUP	GROVE	TOTAL BOXES	U. S. No. 1	U. S. No. 2	U. S. No. 3	CANNERY	Rets. Per Box At Packing House
A	1	1087	956	92	39		62.4c
	2	1249	1068	122	59		60.9c
	3	558	410	128	20		56.3c
B	1	432	239	172	21		52.0c
	2	1858	969	736	153		50.4c
C	1	372	183	148	41		49.4c
	2	509	167	294		48	41.4c
D	1	380	57	256	67		41.4c
	2	1060	247	616	75	122	38.8c

packed U. S. No. 1 while 8.4 fell into cannery grade. The average return was 39.4c per box.

These figures are considered to be highly significant. Group A which received the two control measures showed an increased average per box of 22.3 over Group D, or an increase of over 50%. The average expenditure for the pruning and spraying was 4c per box, which showed a net return of almost 500% on these operations. It must be considered that on the group receiving no control for melanose, a spray application was necessary for rust mites. Therefore it is readily realized that while a very appreciable return was made on these operations in actual money, the groves received at no cost the sulphur and zinc treatment.

Group B which received only the spraying at a cost of 1.6c per box showed an increased return per box of 11.3c. This was an actual return of 600% on the expenditure and the grove received the zinc and sulphur application at no cost.

In considering the cost of melanose control with copper there remains the question of oil spraying which in the minds of many must be charged against the melanose control because of the increment of scale with the increased residue. It has been noted above that none of these groves received nor required an oil treatment. It is nevertheless well to figure the returns of Groups A and B, had an oil treatment been necessary. Using a 1 3-10% concentration of oil derived from one of the standard emulsions and considering that these trees would require 20 gallons for thorough coverage at a cost of 2.2c per box would thereby be incurred. In the Group A groves, this would increase the cost to 6.2c per box but would still show a return of about 300% on the operations. In Group B groves the cost would be increased to 3.8c per box and these groves would then show a return of 200% on the spray investment.

In considering the Groups C and D however, since no melanose spray was applied, no oil control for scale can be charged.

From the experience of the writer over a period of years, it would appear that many scale infestations are charged against a specific spray application while in actual fact much of the scale had been developing for some time prior to spraying.

The Group C groves received a thorough pruning at an average cost of 2.5c per box, but showed an average increased return of 5.3c. This increased revenue showed better than 100% profit on the pruning operations.

While Group D received no spraying or pruning, the grower was forced to pay for the zinc and sulphur application, without benefit of the increased revenue which melanose control returned.

These figures show very decidedly that the spray operations returned the greatest dividend, but that even above this, the thorough pruning was a most profitable operation.

TABLE NO. 2
PERCENTAGE FRUIT GRADES AND AVERAGE RETURNS

GROUP		TOTAL BOXES	U. S. No. 1	U. S. No. 2	U. S. No. 3	Cannery	At. Packing Hse. Rets. Per Box
A	Pruned Sprayed	2894	84.1	11.8	4.1	0.0	61.7
B	Sprayed	2290	52.7	39.7	7.6	0.0	50.7
C	Pruned	881	39.7	50.2	4.7	5.4	44.7
D	No Control	1440	21.1	60.6	9.9	8.4	39.4

Summary

The returns from groups of groves which had received varying treatments directed toward control of melanose were studied. It was found that a copper spray application gave the highest percentage returns based on expenditure, but that pruning sprayed groves increased the monetary returns. Pruning without spraying showed a definite value but not as profitable as one spray application.

The groves included in these studies are only a small percentage of the total number which might be included without varying the data.

It should be noted that the spray dates will be dependent upon weather conditions, cultural practices and blooming periods.

Production men must consider these factors of vast significance in the proper timing of the melanose sprays for greatest returns.

Valuable assistance has been given by L. W. Ziegler in the preparation of this manuscript.

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FACTORS INFLUENCING THE DEVELOPMENT AND CONTROL OF SCALE INSECTS ON CITRUS

(Continued from page 5)

of the leaves examined were either free or had less than a total of 10 dead and living scales on any of the leaves. Spencer and Osburn (1) use the total number of dead and living scales as a guide to designate whether certain treatments are effective during the season. To make a general grove inspection practical, the following method is suggested for trial. Have a card headed for four different classes of leaf infestation, as, leaves free of scales, 1 to 10 scales, 11 to 25 scales, and 25 plus scales. Examine 25 leaves selected at random from the outside canopy of the tree and record the degree of leaf infestation under the respective class. When 25 leaves have been examined select another tree and follow the same procedure. By going diagonally across the grove and skipping three or four rows each time, a fair sample of leaves will have been examined.

By comparing detail counts of scales with counts taken as described above the following results were obtained. In a series of plots where the leaves had less than an average of one living scale per leaf there was between 65 and 75 per cent of the leaves in the combined class of Free and 1 to 10 scales, and for that degree of infestation the lime-sulfur program can be used. In another series of plots that had an average of from 2 to 3 living scales per leaf there was only 20 to 30 per cent of the leaves in the Free and 1 to 10 class. This infestation would call for an oil spray. If only 5 to 15 per cent of the leaves are in the lightly infested class, oil should be used without question.

The above methods of inspection consumes more time than walking

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Cover Crops And Their Relation To Citrus Insects

By J. R. Watson
ENTOMOLOGIST, FLORIDA EXPERIMENT STATION

Much has been said about the beneficial effects upon the soil fertility of a cover crop. Perhaps not as much has been said about the effect of a good cover crop upon the insect pests of citrus. Our citrus growers are all well acquainted with the great help that they receive from the entomogenous fungi, those fungi which live upon and destroy some of our most important insect pests of citrus, especially scale insects, whiteflies and rust mites. We all know that these fungi flourish best during the warm, moist, rainy season. It is evident, therefore, that anything that has a tendency to increase the humidity in a citrus grove will have a tendency to favor the development of these fungi. This effect has been particularly noticeable in the case of rust mites. In groves with a good cover crop rust mites are uniformly less troublesome than in groves otherwise similarly situated, and handled, but without a cover crop. Indeed, some groves in Florida in low hammock regions which are never plowed or cultivated and with good moisture conditions are never much troubled with rust mites. The cover crop aids the development of these fungi in two ways. Probably most important is that it prevents the reflection of the sun's rays from the surface of the soil. One needs only to get into a clean cultivated field any sunshiny day at this season of the year to appreciate the glare of the light and heat from a bare soil. Indeed, the sand in such groves gets so hot as to be uncomfortable to the hand. The humidity of the air bears an inverse ratio to the temperature, that is, as you heat air it becomes drier since warm air has a greater capacity for absorbing moisture than cold air, so a good cover crop by diminishing the reflection of heat from the surface of the ground, particularly sandy soil on which so many of our citrus groves are planted, raises the relative humidity in the groves and makes conditions more favorable for entomogenous fungi to do their work. Furthermore, the cover crop gives off in the process of its growth a considerable amount of water. This also helps to raise the humidity of the grove so that a good cover crop is an important means of controlling scale insects and whiteflies and especially rust mites. Mealybugs and aphids are liable to be attacked by entomogenous fungi.

Now in regard to which cover crop is best for this purpose, it is evident that the one which covers the ground most completely is most beneficial. One which grows tall and makes a dense shade such as the crotalarias would be especially beneficial in this regard. Of course on soils where other cover crops make a better growth than the crotalaries, they would be more beneficial as encouragers of the entomogenous fungi.

A cover crop may also attract enemies of our citrus insects. An example would be aphids. Many grasses, especially crab grass, in the spring are apt to be attacked by aphids. There are not the same aphids which attack citrus, not the green citrus aphid, the melon aphid, not the brown citrus aphid, but these aphids on grasses attract enemies of all aphids, especially ladybeetles and syrphus flies and these insects increasing in large numbers in the grove will help just that much in keeping down an attack of the citrus aphid. Unfortunately, to get much benefit from the presence of these beetles in a grove, it will be necessary to have the cover crop growing in the grove during the winter. In most citrus groves this is not practical but in very young groves, particularly Satsuma groves in the northern part of the state, a cover crop of oats, vetch or Austrian winter peas would be a good insurance against damage from the citrus aphid in the spring. All these plants are apt to be attacked by aphids. These in turn will attract ladybeetles, syrphid flies and other predators of aphids when they have cleaned up the aphids on the cover crop will migrate to the trees and feed upon the citrus aphid.

Crotalaria striata is the most important summer and fall food, and often winter food as well, of the Chinese ladybeetle, which is doing such excellent work in controlling aphids in three counties of Florida.

An important qualification for any cover crop is that it must not breed insects which are liable to attack citrus. The only insects which are liable to breek on our common cover crops which are dangerous to citrus are the plant bugs, of which there are several species. Most common and injurious in the round orange belt is the southern stink bug, often called "pumpkin bug," whereas the most dangerous one in the satsuma belt is the leaf-footed plant bug, a brown insect with a yellow band across its wings. These are liable to breed in large numbers on most of the legumes which are our most valuable cover crops in citrus groves. Most liable to breed them are cowpeas, followed in order by **Crotalaria striata**, beggarweed, and velvet beans. **Crotalaria spectabilis** when grown in a pure stand has never produced a bad infestation. The grasses, if not mixed with wild legumes, are not apt to breed these plant bugs. This does not mean that we should avoid these very desirable legumes as cover crops in our groves, but does mean that we should be on the lookout for these bugs and take precautions against them. The crotalarias do not breed these bugs in large numbers until they begin to produce pods. **Crotalaria striata** is already producing pods in our groves and will continue to produce them in increasing numbers all spring, summer and fall, thus giving the plant bugs a continual food supply. The pods of

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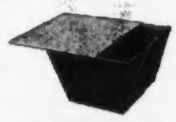

3 and 9 Gallon Smudge Pot

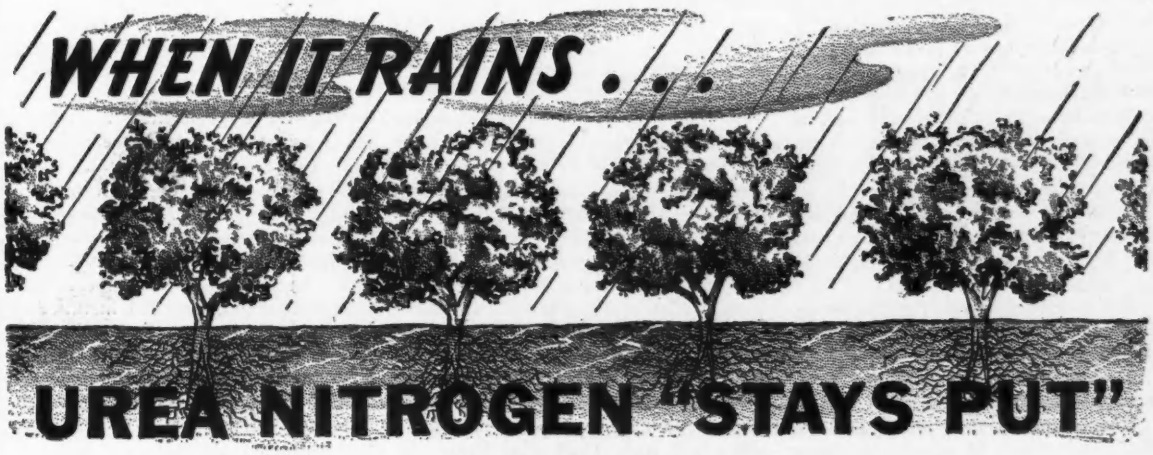
Crotalaria spectabilis are just as attractive as those of **striata** but this plant does not ordinarily produce large number of pods until early fall — September. It then sets a very large crop which quickly ripens. In other words, the pods are present on the plants such a short time that plant bugs do not have time to breed up to large numbers. We have never had any trouble with these bugs where we have had a pure stand of **spectabilis**, but **spectabilis** does not grow well in some of the drier soils of some of our citrus groves. In such soils **Crotalaria striata** can be grown but it should be watched. To be perfectly safe, it should be mown when it begins to blossom. If not allowed to produce pods it will not breed plant bugs in large numbers. Of course, this would necessitate reseeding the grove each year. But often it will not be necessary to cut this **striata**. Stink bugs, like other insects, have their enemies which often hold them in control, so that a crop of **Crotalaria striata**, cowpeas, or beggarweed does not necessarily mean a heavy infestation of pumpkin bugs; but it should be watched.

If by the middle of September there is a considerable number of these bugs on the cover crop, it should be mown. In the case of a tangerine grove, this mowing should be not later than the first of September, and in the case of satsumas the middle of August. These bugs will breed on the stems of cowpeas and beggarweeds as well as on the pods.

It is very important that these cover crops should not be mixed in a grove. In other words, avoid having a continued food supply for these bugs throughout the summer. What may happen if they are mixed was demonstrated strikingly a few years ago in a satsuma grove in West Florida. The owner wanted to compare cowpeas, **Crotalaria striata** and beggarweed, so he planted a third of his grove to each. The plant bugs began to breed on the cowpeas in early summer. As they died down they migrated to the beggarweed in thousands. As this died down in later summer they mig ated to the **Crottlaria striata** in hundreds of thousands, where they again bred in such large numbers that they took all the pods off. The next migration was to the satsumas which were a total loss. The owner unwittingly provided a constant food supply for the bugs all summer.

Avoid mixing cover crops which will breed pumpkin bugs in the first part of the summer with those which will breed them in the latter part of the summer. Herein lies the danger of **Crotalaria striata**. Beggarweed and cowpeas die down to a considerable extent before the citrus is attractive to the stink bugs, but **Crotalaria striata** is liable to carry over the bugs up to the time the citrus is attractive to them. As long as the pods are on the crotalaria the stink bugs will not leave them for citrus. It is only when something happens to the pods; they get ripe or a drouth or hurricane strips them from the plants, or when the bugs themselves get so abundant as to take the pods all off is there a migration to the citrus.

In conclusion, a good cover crop in a grove is a great help in controlling insects, and especially rust mites. The only danger is that some of the legumes may breed plant bugs These should be watched and if they become heavily infested should be mown before the middle of September in the case of round oranges, the first of September in the case of tangerines and Parson Browns, and the middle of August in the case of satsumas.



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**Nels Benson and R. M. Barnette, in Journal of the Amer. Society of Agronomy, Jan. '39. Reprints on request.*

E. I. DU PONT DE NEMOURS & CO., INC. . . . Ammonia Department . . . Wilmington, Delaware

Control Of Cottony-Cushion Scale

By E. W. Berger
ENTOMOLOGIST, STATE PLANT BOARD

Here we are again, ready to tell growers something about the control of Cottony-Cushion Scale. While this insect, with its large white fluted egg-sacs, so readily visible, may become a severe pest, yet it is one of the easiest to be controlled as will appear later in this paper. As stated, the insect is readily visible because of the white or whitish cottony material on its body. But when the white fluted egg-sacs are being formed it even becomes conspicuous especially when full grown (egg-sacs may reach a length of one-half inch and nearly one-fourth inch in width).

The immature scales, from the minute pink crawlers on up to the stage preceding the development of the egg-sac, look very unlike the mature scales and congregate mostly on the bottoms of the leaves of infested trees or plants, living on the liquids that they suck from the leaves through their sharp penetrating beaks. In other words, the Cottony-Cushion Scale is a sucking insect as distinguished from those that bite and chew the plant parts on which they feed.

When the stage of growth arrives at which the insect is about to develop its egg-sac and produce eggs, most of them move from the leaves to the bark. Hence the apparently snow-white clusters of Cottony-Cushion Scale on twigs, but also at times on larger limbs and trunks.

While citrus, roses, pittosporum, plumbago, and pecans are more frequently infested by this scale, there are two or three hundred other plants listed as hosts.

There are, further more, at least two other kinds of insects that may be and have been mistaken for Cottony-Cushion Scale. These are mealybugs and the Cottony-Maple Scale. Mealybugs are common enough, while the Cottony Maple Scale is of rather infrequent occurrence in Florida. Confusion of these insects with Cottony-Cushion Scale has been so frequent, however, that we now regularly expect correspondents requesting Vedalia (Australian Lady-beetle), which is the great specific for the control of this pest, to send us plenty of sample material for identification. Sending specimens is very important as the Vedalia is of no value in the control of other insects.

We furthermore require the Cottony-Cushion Scale, that we expect correspondents to send us, for feeding young Vedalia that we raise in the laboratory, and were it not for our ability to thus raise a goodly part of the needed supply of Vedalia, we would be out of a supply much oftener than we now are.

Now the great specific for the control of Cottony-Cushion Scale, named in the two preceding paragraphs. This is the Vedalia (Australian Lady-beetle). When in 1888 the Cottony-Cushion Scale was about to put the citrus growers of California out of business, it is reported that following the introduction of the Vedalia, the scale-pest in question was under control by the end of eighteen months.

Likewise, when in 1900 the Vedalia was established in what had developed into a rather threatening infestation of Cottony-Cushion Scale near Clearwater, Florida, control of the pest was complete after a few months.

But who, or what, is this Vedalia? It is a small brick-red lady-beetle having relatively large black spots on its wing-covers. It multiplies only on Cottony-Cushion Scale and has never failed to control, often to eradicate an infestation of this pest.

Will add here that the Entomological Department of the Plant Board has been distributing colonies of this most useful beetle since about 1916, and is still doing so. We send them out in colonies of ten, generally in the resting, or pupal, stage of development. The charges are one dollar per colony, a colony generally being sufficient for getting them established in an infested property. While the Plant Board expects us to send the colonies of Vedalia out only upon receipt of remittance or C. O. D., we prefer receiving the remittance in advance as we like to save the time and labor required in making out the C. O. D. blanks. It is also at the same time when a grower makes his request for Vedalia, that we like to receive samples of the scale for identification. As previously stated, we also need this scale for feeding young Vedalia that we raise in the laboratory, and it is for this reason that we like to receive plenty of scale. A shoeboxful of small twigs well infested, or one-half cupfull of loose scale, is indicated. If scale is not available in such quantities, send what you can, if only twenty or thirty of the mature scales with the white egg-sacs attached.

But where did the Cottony-Cushion Scale come from, and then also the Vedalia? Cottony-Cushion Scale was first observed in California in 1868 or 1869. It was traced to Australia, and presumably brought from there to California on some Acacia **(Acacia latifolia)** trees. By the end of twenty years (1888) the infestation and spread of the scale had become so great that citrus growers of California were becoming desperate.

At the suggestion of entomologists, principally of Professor C. V. Riley of the United States Department of Agriculture, Entomologist A. Koebele was sent to the Melbourne Exposition (1888) with instructions to spend his spare time in making a study of the Cottony-Cushion Scale and its natural enemies. The outcome was that out of the sending of something like 127 Vedalia to California, these multiplied so rapidly that, as already stated, control of the Cottony-Cushion Scale was achieved in about eighteen months.

And while this successful introduction of a predatory insect to control an insect pest was made over fifty years ago, it still remains the most outstanding and classical instance of its kind.

The successful introduction of the Vedalia near Clearwater, Florida in 1900 has already been referred to.

Finally Cottony-Cushion Scale can be controlled by spraying with oil-containing sprays and lime-sulphur solutions if need be. However, why use a difficult and messy procedure when the Vedalia works while you go fishing.

And strong sprays of water from a garden hose must not be overlooked, as such may be used to dislodge large quantities of Cottony-Cushion Scale, if necessary, while awaiting the arrival of a colony of Vedalia.

Palm Beach county farmers had received more than $88,000 in soil conservation payments by June 1, according to Agent M. U. Mounts.

FACTORS INFLUENCING THE DEVELOPMENT AND CONTROL OF SCALE INSECTS ON CITRUS

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through a grove but an hour of close inspection may save an extra oil spray as well as a pruning bill. With practice the estimate can be made in a short time and the record is helpful for later references. While making the inspection, care should be taken to observe the inside leaves and twigs.

Florida red scale infestations during the early part of the year are more deceiving than purple scale infestations, necessitating very close observation of the leaves. In groves where red scale is a yearly occurrence the oil spray is applied as a matter of course, especially if copper and zinc sprays have been used. Where there is an uncertainty about the possibility of the infestation, close observations of the leaves and fruit should be made during the period between May and early August. If by May 15 to June 1 only an average of one to two scales per leaf are on the present year's growth, the oil spray should be applied by the first of July. Repeated observations should be made because the new growth obscures the older foliage which is the source of infestation. Even though 90 to 95 per cent of the scales are dead on the old foliage a heavy infestation may develop from the few remaining living scales. The following results of red scale counts made from a grapefruit grove at Vero Beach illustrates the importance of close observations. In January, 1937, on old leaves picked at random, there was an average of 70 living scales for each 100 leaves and of a total of 7000 scales examined only 8 per cent were living. On June 24 another count was made from old and new leaves picked at random and there were 90 living scales for each 100 leaves, which to all appearances and from the actual scale count was not a threatening infestation, but it should be remembered that the majority of leaves collected were from the spring flush of growth. By November, despite an oil spray, the infestation had increased from 90 to 1180 living scales for 100 leaves, with a total of 4720 dead and living. In January, 1936, in duplicate plots where there was an average of only 300 total dead and living per 100 leaves with 25 per cent of them alive, the infestation increased by September to over 16,000 dead and living per 100 leaves with an average of 6,000 living. That increase followed a dormant bordeaux 6-6-100 and three lime-sulfur-wettable sulfur sprays. The infestation in 1936 was exceptional, but illustrates what may happen if proper precautions are not taken.

Factors Influencing the Control of Scales

Factors influencing the control of scales are almost as numerous and varied as those influencing their development. Some of the factors may be classed as, (1) the stage of growth the majority of scales are in at the time the scale-cide is applied, (2) the degree of infestation, (3) the type of trees to be sprayed, (4) the method of application of the spray, (5) the kind of equipment used to apply the spray, and (6) the concentration of the scalecide.

The highest percentage of kill can be obtained when the scales are in the very young stages of growth. It is especially important to apply lime-sulfur sprays at the peak of crawler emergence, if satisfactory results are to be expected. Because of the more toxic effect of oil to mature scales the timing according to the stage of scale growth is not so important as with sulfur sprays, but the oil sprays are most effective about two weeks after the peak of crawlers. Crawlers and first stage scales were more abundant than any other stages of purple scales five weeks after an oil application which indicated that the scales that were not killed by the oil were the more mature ones and those in the egg stage. Because of the variation in weather, especially during the winter months, a more accurate timing of the sprays can probably be made by observation than by following set dates. During the months of December, January, and early February, scale crawlers are usually scarce, but in January of 1938, there was a high percentage of crawlers of both Florida red and purple scales. The average spring hatch of crawlers usually occurs in late March and early April, but in 1938 it did not occur in groves under ob-

(Continued on page16)

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There is no adequate substitute for a commercial dosage of "VOLCK" for a *general clean-up* of *citrus insect pests.*

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Gleanings

As we sit here overlooking the Gulf of Mexico from the very comfortable porch of our Sarasota Beach cottage it occurred to us that it would be fine to have all our good Lyons Fertilizer customers and friends here along with their families to enjoy this fine day, and just relax to the utmost even forgetting the cares of the grove or farm back home. This, however, is impossible, so with Arthur and Elizabeth Belleau, and our 'kin' from South Carolina, Rut and Mary Liles, we hope that everyone of you will have an opportunity of spending a most enjoyable vacation at the place of your choice.

We talked with Jack Smith, manager of the Sarasota store of J. C. Smith & Son, recently. Jack is staying at the beach for a month. At least he is spending the nights there, but it affords him a great deal of pleasure to know that his wife and babies are enjoying a real nice vacation.

We have several customers who are getting very good prices for marsh seedless grapefruit. A. F. Pickard of Lakeland tells us that he is getting a very good average at this time for both his grapefruit and valencia oranges.

Attention Growers! This is vacation time, and as you ride over the state and talk with various friends, you will find that the groves fertilized with Lyons Fertilizer are always in splendid condition. We are ever ready to serve you, so just let us know your convenience.

John Snively, Jr., able grove manager of St. Helena Groves, is in Detroit for the marriage of Sidney Smith, former Havenite. John, Jr., is the best man.

STICKING one's neck out is a common failure of a lot of folks including this writer. But despite the annoying consequences of such a habit we cannot resist the opportunity to suggest that now, during the summer season, would be a splendid time for the citrus industry to set up definite plans for the handling of its next season's crop rather than waiting until the middle of our shipping season.

We know from experience that trying to work out our difficulties at a time when marketing problems are at their worst is always a tiresome, unsatisfactory method which usually ends up by accomplishing very little.

On the other hand we know now approximately how much of a crop we will have during the forthcoming season. We can anticipate the marketing problems which will confront us as the result of the knowledge we have of Texas and California crops.

So, as we see it, the time for us to prepare to handle any difficulty which it may appear to us now may arise is to do so right now while we are less occupied with the activities of marketing than we will be in mid-season, and also before we find ourselves in trouble right in the busiest part of our year.

Relatively few problems are confronting the major portion of the leaders in the citrus industry at the present time. Their minds are free to give uninterrupted attention to the problems which inevitably arise in the midst of the season, and which are predictable now to a degree, so why not work out plans that are potentially correctives for problems which arise each year — now?

Working under stress, as everyone is in mid-season, is not the best time for clear thinking, constructive planning or the giving of the time and effort needed to make the details of any plan workable and acceptable to the industry as a whole.

True, the outlook for the coming season appears now to be less fraught with difficulties than the season just closed, but every member of Florida's great citrus industry is vitally interested in ways and means of taking a more substantial profit out of his investment in that industry.

Certainly there is no better time than now to give serious consideration to the accomplishment of that purpose.

W. L. Lyons Jr

The recent flurry of unsettled weather over Florida brought the finest rain that we have had in two years. With several more of these "rain for a week" spells our water table would get back to something like normal.

John Giddens of Avon Park is considered one of the best grove caretakers in his section. His groves are always in tiptop condition, and naturally uses our fertilizers. As a hobby John does considerable flying over the citrus section of Florida.

JULY SUGGESTIONS FOR GROVE CARE

Horticultural Department
Lyons Fertilizer Co.

CULTIVATION:

Continue harrowing of young trees only allowing cover crop to grow in middles. Hoeing may also be necessary in order to control grass and weeds next to trees.

SPRAYING:

Rust mites will require close watching at this time. Dust with sulphur or spray with lime sulphur if these insects appear. If scales or whiteflies become numerous spray with oil emulsion. Whiteflies should be sprayed about ten days after the main flight has disappeared. This is a good time to introduce friendly fungi for control of whiteflies.

PRUNING:

Complete pruning as soon as possible. Trees that are relieved of dead wood will make better growth this summer. Keep down water sprouts and root-stock sprouts.

COVER CROPS:

Suspend cultivation in bearing blocks, and allow cover crop to grow. Pull up poke weeds and citron vines, and pull may pops and other vines out of trees.

GENERAL:

Missing trees may be replaced now. Clean out drainage ditches. Fix up your fences and hoe out fencerows.

The Dover Cash Feed Store, Dover, one of the leading organizations in this section, have recently been obtained by our Company as an agent for the Dover territory. We welcome these people as associates of the Company and assure them of our wholehearted cooperation.

Mr. and Mrs. Samuel Schutzman, owners of a model grove near Eagle Lake, are enjoying the New York World's Fair. This model grove is fertilized with Lyons Fertilizer.

Long range prediction: Seedy varieties of grapefruit are going to sell at a good price during the coming season.

Because these Products are Manufactured in Florida for use on Florida Groves

We Recommend

ORANGOL SPRAY EMULSION

OBRITE DUSTING SULPHUR

"SUPERIOR" WETTABLE SULPHUR

For control of citrus insects and disease

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Little Bits of FUN

MINOR LEAGUE STUFF

"What did you think of the big fight last night, Bill?" asked the retired boxer of his pal.

"Fight?" retorted Bill scornfully. "If the missus and me 'ad put up a show like that on Saturday night the kids would 'ave booed us."

ALMOST FORGOT

Pa: "I think I'll have to go downstairs and send Nancy's young man home."

Ma: "Now Elmer, don't be hasty. Remember how we used to court."

Pa: "For gosh sakes; I hadn't thought of that. Out he goes."

HANDICAPPED

"Are we going to try out young Roberts for the football squad?" asked the captain.

"No," replied the coach; "anybody who can spell such words as plenipotentiary, erysipelas, and plebiscite is no good as a football player."

CHEAPER THAT WAY

Then there's the one about the tiny girl who asked her Scotch parents:

"Mother, what are prayers?"

"Messages to heaven, my dear," repied the mother.

"Then that is why father always says his prayers at night—to get the low rate."

It is always a pleasure to visit with Harry Harris, the confirmed bachelor of Eustis. In years past we haven't had the opportunity of seeing him as often as we would like, but now that this man is giving us his fertilizer business we will be able to spend more time with him. Harry is making an outstanding success as both grower and shipper in Lake County. He has one of the nicest packing houses in the state.

FACTORS INFLUENNCING THE DEVELOPMENT AND CONTROL OF SCALE INSECTS ON CITRUS

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servation until the last week in April.

The degree of infestation is an important factor in scale control, especially with purple scales. A "pile-up of scales" is the term used where there are several layers of scales. The top ones are dead but they are a protection for crawlers which settle under the dead mass of scales. When such a condition exists the sprays do not penetrate through the mass of dead scales in sufficient quantity to kill those next to the surface of the leaf. As was stated before this Society last year (2), the same percentage of reduction may be obtained with an oil spray on a heavily infested tree as on a lightly infested one, but there are still enough living scales remaining on the heavily infested tree to reinfest it in a year's time. To illustrate more clearly, trees within the same block that were infested in varying degrees with purple scales were classed as lightly, moderately, and heavily infested.

The trees were sprayed with an oil emulsion in October. Before the trees were sprayed there were three times as many scales on the heavily infested plots as on the lightly infested ones. Five weeks after the spray there were ten times as many scales on trees that were heavily infested as on the more lightly infested ones, yet there was only a difference of five percent in the reduction of living scales per leaf. Five months after the spray was applied there was still over three times as many living scales on the trees that had been heavily infested. The change in ratio between the scale population during the period five weeks after and five months after the oil spray is explained by the fact that there was a continual dying back of wood and dropping of weak leaves on trees that had been heavily infested.

The type of trees to be sprayed is an important factor in scale control. High-headed trees are more easily sprayed than low-headed ones or trees with limbs on or near the ground. Also, trees with sparse foliage are more easily sprayed than those with dense foliage and as a rule the foliage on grapefruit trees is denser than on orange trees making them harder to spray. Trees that have dense foliage and a good crop of fruit set should be sprayed just as soon as the fruit is large enough to be sprayed without injury from the oil. If the spraying is delayed until the fruit enlarges to the extent that its weight bends the twigs and limbs, the foliage becomes more compact and thorough coverage is much more difficult. If the limbs touch the ground and the trees are not big enough for a man to get underneath (young trees), the spray gun should be stuck through the foliage to spray the inside. Thorough coverage of inside leaves has not been accomplished on thickly foliaged trees by trying to force the spray through the foliage even high pressures and large openings in the discs were used. The method of spraying the tree is one of the most important factors in such control. Results of experiments in 1937 on methods of spraying were reported last year (2), but the experiments were repeated in 1938 with similar results which were, a 32 percent reduction of purple scales on trees sprayed only from the outside; 78 per cent reduction on trees sprayed from the inside by sticking the spray gun through the foliage and the outside as usual; and a 94 percent reduction by spraying the inside of the tree from underneath it and the outside by the usual method. The trees in the experiment were Pineapple orange trees that were well foliated and averaged about sixteen feet in height.

Suitable equipment is a factor influencing scale control. Sprayers supplying sufficient pressure and volume of spray should be used in order to force the spray through the foliage and to reach the tops of the trees. The spray guns should be short enough to be easily handled underneath the trees and should be the type that can be regulated to form a wide mist for the lower limbs and a more forceful stream to reach the tops of the trees both inside and outside. As reported last year (2) the leaves near the inside center of the tree were as heavily infested as the ones lower down. If residue sprays have been used it is very important to obtain a good coverage on the tops of the trees as well as on the lower limbs. The size of the openings in the discs is an item to be considered. On the average, purple scales were reduced to a greater degree when discs with the larger openings were used, with little or no increase in cost when the time of operation was considered, than with discs with smaller openings. To illustrate, with the single nozzle spray gun the percentage of reduction of purple scales was greater with no additional cost where a No. 8* or a No. 9 disc was used than where a No. 5 disc was used. The results were quite similar when two No. 5 discs were used in the double gun compared with No. 3's, and with the four-nozzle broom gun either four No. 4's or a combination of two No. 4's and two No. 5's were more satisfactory than two No. 2's and two No. 3's. The larger the aperture in the discs the greater the volume which aids in turning the foliage, resulting in a more complete coverage.

The concentration of the material used should be considerad. Oil emulsion sprays at concentrations of 1¼ to 1½ per cent actual oil have proved satisfactory for the average infestation of purple scales, but where very heavy infestations existed a concentration of 1⅔ per cent oil was more satisfactory. The 1⅔ per cent oil concentration has been more effective against Florida red scale than 1¼ to 1½ per cent concentration. Lime-sulfur 1-50 plus wettable sulfur 6 to 8 pounds per 100 gallons should be used when scale control is being attempted. According to Yothers and Miller (5) a very high percentage of young scales was killed with a 1-25 lime-sulfur. By adding wettable sulfur to 1-50 lime-sulfur, the sulfur content can be increased without increasing the danger of injury to the trees and during hot weather it is advisable to use a more dilute solution of lime-sulfur and increase the wettable sulfur content so as to equal about a 1-25 lime-sulfur spray. In plots where the sulfur sprays have been applied in a dilute form such as a 1-100 lime-sulfur plus 5-100 wettable sulfur, purple scales have increased to a marked degree. Some of the limiting factors of lime-sulfur sprays are, (1) one application is not as toxic to scales as one oil spray, (2) more exact timing for the application is necessary, (3) if hard rains follow soon after a sulfur spray there may not be enough sulfur remaining on the leaves to be effective against crawlers, and (4) most of the men who do the actual spraying object to lime-sulfur sprays because of the burning effect on the face and eyes. The average spray hand will not get underneath the tree when spraying with lime-sulfur which results in a very poor coverage for scale control. Although it is just as necessary to obtain a thorough coverage with lime-sulfur as with oil, a very small percentage is applied in a thorough

*The disc number corresponds to the size of the aperture in the disc measured in 64ths of an inch. Thus a No. 8 disc has an aperture of 8/64" in diameter.

manner

In the discussion on control your speaker has dealt mostly with the results obtained with oil sprays because they have been more satisfactory during the past three years, especially since infestations have been heavier and more frequent The main objections to oil sprays have been the cost, which is still a factor, unsatisfactory control of rust mites, and the possibility of injury in the form of fruit and twig injury and a heavy leaf drop. During the past six years in the experimental work there has been no more evidence of injury caused by oil than with lime-sulfur. There has been more fruit injury with lime-sulfur than with oil emulsion sprays, and no more dead wood was observed in oil sprayed trees than those sprayed with lime-sulfur. Although a heavier leaf drop may follow an oil spray than a lime1sulfur application the total for the year will probably be greater following lime-sulfur because it is necessary to make repeated applications. In an experiment that has been conducted for four years at the Citrus Experiment Station, duplicate plots of eight trees each of Pineapple orange have been sprayed with oil emulsion once a year with two to three light applications of sulfur sprays to control rust mites; two other plots received four to five thorough applications of lime-sulfur 1-50; and two others received a 90 per cent wettable sulfur at the rate of 7 1-2 pounds per 100 gallons of water. At the end of four years the average yearly fruit production per tree was 14 pounds higher from the wettable sulfur plots than from the oil plots and 31 pounds per tree more than the trees in the lime-sulfur plots, amounting to a difference in production of 1,800 or more pounds per acre, depending on the number of trees. During a six-year period before the experiment was started, the average production per tree in all plots did not vary more than five pounds. There may be a correlation between leaf drop and fruit production because the total leaf drop per year has been somewhat heavier in the lime-sulfur plots than in the oil plots and lightest in the wettable sulfur plots. Ziegler (6) states that the fruit production was somewhat reduced and the fruit was smaller on trees that had a heavy leaf drop following a very thorough oil spray applied when the fruit was small. Other workers have obtained similar results in very extensive studies which will be cited in a later publication. In 1938 there was slightly less dead wood by weight in the oil sprayed trees than in those sprayed with sulfur but there was also a lighter infestation of scales in the oil plots. Even though there was not a heavy infestation in the sulfur plots the scale population had increased following a zinc sulfate-lime application in 1937 and some of the small inside twigs and limbs were rather heavily infested. This in all probability accounted for the additional amount of dead wood in those plots.

Purple scales and other undetermined factors are probably more directly responsible for dead wood in the trees than the spray material. In one experiment the dead wood that developed during a five-month period after an oil spray was roughly in proportion to the degree of infestation prior to spraying. In this experiment trees in the same row were infested in varying degrees by purple scales. Before the spray was applied the infested trees were classed as lightly, moderately, and heavily infested, not only from appearance but from scale counts. Practically all of the dead wood was pruned out of the trees in each class. After a period of five months the trees were again pruned and the dead wood weighed. There was twice as much dead wood in the moderately infested trees and four and one-half times as much in the heavily infested trees as in the lightly infested ones. In a 38-day period after the spray the total leaf drop was also much heavier from the heavily infested trees than from those with a lighter infestation. Some of the trees were not pruned before being sprayed and five months later the contrast was very marked in the abundance of dead wood in the unpruned trees compared to the pruned ones. The results of that experiment indicate that twigs weakened by heavy scale infestations probably die sooner following the oil spray. There were not enough pruned trees in the check plot to make a fair comparison but there was not quite as much dead wood in the heavily infested trees in the check as in the heavily infested oil-sprayed trees.

The conclusions reached from our experimental work to date are summarized as follows: Factors influencing the development of purple, and red scale to some extent, are that those species of scales increase more rapidly following inert residue and fungicidal sprays than where such sprays are omitted; and that trees supplied with certain elements such as zinc and magnesium, besides the regular fertilizer, are more suitable for purple scale development because of the higher percentage of green leaves and increased foliage which stays on the tree longer in addition to creating more shade. Dense foliage also makes the trees more difficult to spray. As to factors influencing purple scale control, oil emulsion sprays at a concentration of 1 1-4 to 1 1-2 per cent oil have been more satisfactory than sulfur sprays but light scale infestations have been held in check by sulfur sprays when applied in a thorough manner three to four time a year. Sprays should be timed so that the trees can be sprayed before the foliage is compact from the weight of the fruit and when a large percentage of the scales are in a young stage of growth. The scalecides should be sprayed on the inside as well as the outside of the trees in order to thoroughly cover the trunk, limbs, and under surface of the leaves. More satisfactory control has been obtained when the spray guns were fitted with discs with a larger aperture than with a smaller one.

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EXPERIMENT STATION ISSUING BULLETIN ON CITRU SMALNUTRITION

Symptoms which differentiate one citrus nutritional deficiency from another are described in detail in a bulletin soon to be published by the Florida Agricultural Experiment Station, it has been announced by Director Wilmon Newell. He says there has been much interest, accompanied by considerable confusion, in nutritional troubles affecting Florida citrus, and the new bulletin clears up practically all of the confusion.

PLANTING CROTALARIA AS A COVER CROP

(Continued from Page 6)

observed corn, cotton, peanuts, sweet potatoes, citrus trees, pecan trees and other crops following them. It is not uncommon for the corn or sweet potato yield on the lighter soils to be doubled following three or four crops of crotolaria. One can reasonably expect an increase from three to five bushels of corn per year. Yields may be doubled in one year.

At the end of a seven year experiment on young (just set) citrus trees when every other factor has been kept constant, the average cross section **area** of **tree trunks** on plots receiving various kinds of summer legume cover crop treatments were as follows: Crotolaria 19.49 sq. inches; Beggarweed 1748 sq. inches; Velvet Beans 1617 sq. inches; Cowpeas (single plot) 16.33 sq. inches; and clean culture 13.93 sq. inches.

Fruit yield in boxes per acre on the same cover crop experiment were as follows: Crotolaria 169.5 boxes; Beggarweed 135.4 boxes; Velvet Beans 114.7; Cowpeas (single plot) 91.3 and on clean culture plots 40 boxes.

A humus and nitrogen determination in a potato-legume, corn-legume rotation showed the following results: Crotolaria, 18,920 pounds humus compared to Beggarweed 16,580 pounds, Velvet Beans 18,200 pounds; and cowpeas 18,200. Nntrogen Crotolaria 514 pounds, Beggarweed 464, Velvet Beans 472 and Cowpeas 488.

A further study of the decomposed organic matter and nitrogen content of soil at various depths of summer cover crop plots secured to indicate "decomposed soil organic matter" despite the return of large quantities of rough or organic matter was hardly maintained and the decrease in the clean cultivated was significant and progressive. It showed further that the nitrogen content of the surface soil was evidently being maintained.

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UNFAMILIAR TERMS ABOUT FUNGI

(Continued from Page 7)

structures known as **conidiophores.** These forms of the mycelium may be almost like it or they might be highly specialized and different representatives of the mycelium-like condition. Suppose we let a hundred yards of stove pipe represent the mycelium to which are fastened, at short intervals, clusters of toy circus balloons which are the **conidia.** In a specialized form of conidiophore, suppose grapefruit trees full of fruit grew out of the stove pipe at certain intervals with the fruit representing the **conidia.** These are representations of what is seen through the microscope when a **sporulating** fungus is observed. Without the microscope no **spores** or **conidia** would be seen and probably no **mycelium** unless there were large masses of it.

The Florida farmer who is fundamentally a producer of plants should become conversant with some of the terms of the plant pathologist in relation to plant diseases, inasmuch as his crops are continually menaced by them and for the protection of which he is continually required to apply remedial measures suggested or recommended to him by some one more familiar with the disease problem.

The plant pathologist works in a technical laboratory and thinks in scientific terms. He is highly specialized and his contacts with plant growers are few. He appreciates and desires more contacts, both in person and in writing, by which means he is able to give the grower expert advice and at the same time help himself in learning of the problems confronting the grower.

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June Grapefruit Condition Lower Than Last Year

Florida's grapefruit crop for the 1939-40 season is given a rating of 54 by the federal government for its condition on June 1, compared with 62 at the same time last year and an average of 66 for the period from 1928 to 1937, in the fruit prospect report of the bureau of agricultural economics recently issued at Washington.

Texas grapefruit rates 64 at the present time, compared with 78 last season and a 10-year average of 59. Arizona shows a heavy drop to 61 from 81 last year and a 10-year average of 85.

The condition of Florida oranges for next season's crop is considerably better than at the same time last season, the federal government states, being rated 74 as against 65 last season and 72 for the 10-year average. This is only for early and mid-season varieties, no report being made on next year's valencias.

California oranges rate 80 in condition at this time, compared with 81 last season and a 10-year average of 84. For all producing areas, the average orange condition is rated at 77, compared with 75 last season and 80 for a 10-year average. The condition of grapefruit from all areas is given as 59, compared with 70 last season and an average of 66 for ten years.

"Most of the Florida citrus belt," the report states, "has a fair supply of soil moisture. Prospects for valencias in this state are relatively better than for early and mid-season varieties. In California, the blossom period has extended over a longer period than usual and in most areas the June drop has not yet begun as a result of the moderately cool weather that prevailed during the month of May. In Texas, Arizona, Louisiana and Mississippi the June 1 condition of oranges was well below that of a year ago. Condition in Alabama was slightly higher than last year."

With reference to grapefruit, the federal report states that most Florida groves now have a "fair supply of soil moisture. Grapefruit trees show a relatively lighter set of fruit than oranges. Texas received beneficial rains during May, although additional moisture is needed in some sections. The fruit set is relatively light in most areas, but growers expect this condition to be partially offset by good sizing In Arizona, heavy winds and rains caused considerable damage during the blooming period, and only a light to medium set is reported Low prices received for the 1938-39 crop have caused Arizona growers to curtail fertilizer applications, and in some cases to allow groves to remain unirrigated. Condition of California grapefruit is below that of a year ago."

There will be no 1939-40 crop estimate by the federal government for any of the producing areas until October, the report states.

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Orange Juice May Be Kept Overnight

Persons who like to squeeze their orange juice at night for breakfast the next morning, letting it chill in the refrigerator, can do so without fear of losing the Vitamin C Potency. Uncle Sam says recent studies have changed his opinion about this loss, and he now sanctions extraction of juice even 24 hours before use.

The bureau of home economics announced its new findings in the May issue of the Journal of Home Economics. Research was conducted on the ascorbic acid (Vitamin C) content of fresh orange juice and other juices as affected by refrigeration. The orange juice was obtained by extracting on a glass reamer and removing the seeds by either a wire strainer or cheesecloth.

The juices were placed in a refrigerator with a temperature of approximately 40 to 50 degrees in jars with loosely fitted lids. Ascorbic acid determinations were made immediately after preparation of the juice and on samples taken from each jar at 24-hour intervals for a period of from three to five days.

The orange juice stored in this way showed a gradual though slight loss of ascorbic acid, beginning about the second day. There was no difference when the juice was strained through cheesecloth or through a wire sieve.

"A previous report from this laboratory," the article stated, "indicated that orange juice kept in a refrigerator six hours might lose as much as 10 per cent of its ascorbic acid value. In view of the cumulative evidence concerning ascorbic acid determinations, this slight initial loss during the first day is not significant since the differences reported are within the limits of accuracy of the chemical method when acetic acid alone is used as the extracting liquid. In the light of present findings, the interpretation of the effect of over-night storage of juices is more lenient than that given in 1936.

"Freshly extracted orange juice in this study showed slight but gradual loss of ascorbic acid, beginning about the second day None of the juices tested lost appreciable amounts of ascorbic acid during the first 24 hours."